

# SCR Catalyst for Simultaneous Control of NO<sub>x</sub>, CO, Non-Methane Hydrocarbon Emissions from Gas-fired Power Plants

William B. Feaver, Harvey S. Rosenberg and Joseph A. Rossin (Presenter)  
Guild Associates, Inc.  
5750 Shier-Rings Road  
Dublin, Ohio 43016  
(614) 760-8007

## Summary

Natural gas-fired power plants are being constructed in favor of coal-fired power plants because of their reduced emissions to the atmosphere. Although NO<sub>x</sub> emissions from natural gas-fired power plants are low (on the order of 25 ppm), many state and local regulations require that NO<sub>x</sub> emissions be reduced to as low as 2 ppm. Selective catalytic reduction (SCR) is a leading technology for the control of NO<sub>x</sub> emissions and has been successfully applied to the control of NO<sub>x</sub> emissions from coal-fired power plants for a number of years. With respect to the gas turbine application, high NO<sub>x</sub> reduction efficiencies (greater than 95%) can be achieved using a conventional SCR catalyst provided the process is operated with excess NH<sub>3</sub>. The drawback to operation with excess NH<sub>3</sub> is that NH<sub>3</sub> slip becomes an issue because SCR catalyst lacks the ability to decompose the excess NH<sub>3</sub>. Consequently, NO<sub>x</sub> reduction efficiency becomes limited by NH<sub>3</sub> slip. In addition to NO<sub>x</sub>, emissions from natural gas-fired power plants also include CO and unburned hydrocarbons. CO and hydrocarbon emissions are beginning to come under scrutiny, and the SCR catalyst has minimal activity towards these compounds.

A novel SCR-type catalyst is currently being developed to control emissions from natural gas-fired power plants. The goal of this development effort is to identify a low cost monolithic catalyst capable of achieving the desired NO<sub>x</sub> reduction efficiency with negligible NH<sub>3</sub> slip. One additional goal of this effort is to incorporate onto the catalyst the ability to oxidize CO and non-methane hydrocarbons. The catalyst under development consists of a washcoated monolith and combines an SCR function with an NH<sub>3</sub> abatement function. The NH<sub>3</sub> abatement function is also active in the oxidation of CO and non-methane hydrocarbons. The addition of an NH<sub>3</sub> abatement function to an SCR catalyst allows for operation with excess NH<sub>3</sub>, thereby ensuring a high NO<sub>x</sub> reduction efficiency. NH<sub>3</sub> slip is minimized/avoided because the excess NH<sub>3</sub> is decomposed over the catalyst. One key to successful implementation of the above catalyst design is for the NH<sub>3</sub> abatement function to decompose NH<sub>3</sub> with minimal selectivity towards the formation of NO<sub>x</sub>.

A novel SCR-type catalyst was evaluated for its ability to decompose NO<sub>x</sub>, CO and toluene (selected as a representative non-methane hydrocarbon) in a laboratory scale test stand using simulated turbine exhaust. Simulated turbine exhaust consisted of 30 ppm NO<sub>x</sub>, 10% O<sub>2</sub>, 10% CO<sub>2</sub>, 5% water, balance N<sub>2</sub>. When operated with approximately 40 ppm NH<sub>3</sub> at temperatures between 240 and 290°C and GHSV's between 12,000 and 18,000 hr<sup>-1</sup>, the catalyst is able to achieve NO<sub>x</sub> effluent concentrations below 2 ppm with less than about 1 ppm NH<sub>3</sub> slip. Operation of the catalyst at temperatures greater than about 290°C results in insufficient NO<sub>x</sub> reduction. This behavior is attributed to excessive NH<sub>3</sub> activity. Operation of the catalyst at temperatures below about 240°C results in excessive NH<sub>3</sub> slip, which is attributed to insufficient NH<sub>3</sub> activity.

The NH<sub>3</sub> abatement function associated with the catalyst facilitates a reaction between adsorbed NH<sub>3</sub> and O<sub>2</sub> leading to the formation of H<sub>2</sub>O and primarily N<sub>2</sub>. Because the catalyst destroys NH<sub>3</sub> according to an oxidation mechanism, the ability of the catalyst to destroy CO and toluene (selected as a representative hydrocarbon) was also evaluated. The CO and toluene activity of the catalyst was evaluated by spiking the process stream with 400 ppm CO and 300 ppm toluene. The catalyst was able to achieve greater than 90% destruction of CO at temperatures of greater than about 200°C, while temperatures of greater than 280°C are required to achieve 90% destruction of toluene.